CLAIMS

We claim:

1. An all fiber optical filter formed from stretching an optical fiber and comprising a fiber optic core, an inner cladding formed concentrically about the fiber optic core, and an outer cladding formed concentrically about the inner cladding, wherein an outer index of refraction of the outer cladding is less than a core index of refraction of the fiber optic core and further wherein the outer index of refraction is greater than an inner index of refraction of the inner cladding.

2. The all fiber optical filter as claimed in claim 1 wherein the optical fiber is stretched until evanescent coupling is achieved between the fiber optic core and the outer cladding.

3. The all fiber optical filter as claimed in claim 2 wherein the all fiber optical filter is configured to receive an optical signal, including a gain, from a fiber amplifier.

4. The all fiber optical filter as claimed in claim 3 wherein the optical signal is filtered by the evanescent coupling between the fiber optic core and the outer cladding to flatten the gain.

5. The all fiber optical filter as claimed in claim 1 wherein the optical fiber is stretched until a filter optical response is approximately equal to a target optical spectrum response.

6. The all fiber optical filter as claimed in claim 5 wherein the target optical spectrum response is an inverse of a portion of an amplifier gain spectrum.

7. An all fiber optical filter formed by stretching an optical fiber and comprising:

a. a single mode fiber optic core having a core index of refraction;

b. an inner cladding formed concentrically about the single mode fiber optic core, the inner cladding having an inner index of refraction, the inner index of refraction being less than the core index of refraction; and

c. an outer cladding formed concentrically about the inner cladding, the outer cladding having an outer index of refraction, the outer index of refraction being less than the core index of refraction, the outer index being greater than the inner index of refraction;

wherein the optical fiber is stretched until a filter optical response is approximately equal to a target optical spectrum response.

8. The all fiber optical filter as claimed in claim 7 wherein the target optical spectrum response is an inverse of a portion of an amplifier gain spectrum.

9. An optical filter comprising:

a. a fiber optic core having a first diameter, a filter length, and a first index of refraction;

b. an inner cladding formed concentrically about the fiber optic core, the inner cladding having a second index of refraction and a first thickness, wherein the second index of refraction is less than the first index of refraction; and

c. an outer cladding formed concentrically about the inner cladding, the outer cladding having a third index of refraction, wherein the third index of refraction is greater than the second index of refraction and less than the first index of refraction, and further wherein the first diameter and the first thickness are of dimensions to promote evanescent coupling between the fiber optic core and the outer cladding.

10. The optical filter as claimed in claim 9 wherein the optical filter is configured to receive an optical signal, including a gain, from a fiber amplifier.

11. The optical filter as claimed in claim 10 wherein the optical signal is filtered by the evanescent coupling between the fiber optic core and the outer cladding to flatten the gain.

12. The optical filter as claimed in claim 11 wherein the fiber optic core further includes an input length with a second diameter and an output length with a third diameter, wherein the input length is coupled to the filter length by a first transition length and the output length is coupled to the filter length by a second transition length, and further wherein the second diameter and the third diameter each are greater the first diameter.

13. The optical filter as claimed in claim 12 wherein the inner cladding includes a second thickness formed about the input length of the fiber optic core and a third thickness formed about the output length of the fiber optic core, the inner cladding having a first smooth variation thickness form the first thickness to the second thickness and a second smooth variation thickness from the first thickness to

the third thickness, wherein the second thickness and the third thickness are each greater than the first thickness.

14. The optical filter as claimed in claim 13 wherein the outer cladding includes an input outer cladding formed about the second thickness and the first smooth variation thickness.

15. The optical filter as claimed in claim 14 wherein the outer cladding includes an output outer cladding formed about the third thickness and the second smooth variation thickness.

16. An all fiber optical filter for flattening gain of an amplified optical signal provided from a fiber amplifier comprising:

a. a fiber optic core having an input length, a filter length, an output length and a first index of refraction, wherein the input length is separated from the filter length by a first transition length and the filter length is separated from the output length by a second transition length and further wherein the first transition length has a decreasing diameter from the input length to the filter length and the second transition length has an increasing diameter form the filter length to the output length;

b. an inner cladding formed concentrically about the fiber optic core, the inner cladding having a second index of refraction and an input thickness formed about the input length of the fiber optic core and a filter thickness formed about the filter length of the fiber optic core and a first smooth variation thickness from the input thickness to the filter thickness, the inner cladding having an output thickness formed about the output length of the fiber optic core, the inner cladding having

a second smooth variation thickness form the filter thickness to the output thickness; and

c. an outer cladding formed concentrically about the inner cladding, the outer cladding having a third index of refraction which is less than the first index of refraction and greater than the second index of refraction.

17. The all fiber optical filter as claimed in claim 16 wherein a core diameter of the fiber optic core and the filter thickness are of dimensions to promote evanescent coupling between the fiber optic core and the outer cladding.

18. The all fiber optical filter as claimed in claim 17 wherein the optical filter is configured to receive an optical signal, including a gain, from a fiber amplifier.

19. The all fiber optical filter as claimed in claim 18 wherein the optical filter is filtered by the evanescent coupling between the fiber optic core and the outer cladding to flatten the gain.

20. A fiber optic communication system for transmitting an optical signal comprising:

a. a transmission system configured to receive and transmit the optical signal;

b. a first length of optical fiber coupled to the transmission system for carrying the optical signal;

c. an amplifier coupled to the first length of optical fiber for amplifying the optical signal thereby forming an amplified signal having a gain;

d. an optical filter coupled to the amplifier for filtering the amplified signal and flattening the gain, thereby forming a filtered signal, the optical filter including:

   i. a fiber optic core having a first diameter, a filter length, a first index of refraction, a first end for receiving the amplified signal, and a second end for transmitting the filtered signal;

   ii. an inner cladding formed concentrically about the fiber optic core, the inner cladding having a second index of refraction and a first thickness, wherein the second index of refraction is less than the first index of refraction; and

   iii. an outer cladding formed concentrically about the inner cladding, the outer cladding having a third index of refraction, wherein the third index of refraction is greater than the second index of refraction and the third index of refraction is less than the first index of refraction, wherein the first diameter and the first thickness are of dimensions to promote evanescent coupling between the fiber optic core and the outer cladding to flatten the gain of the optical signal;

e. a second length of optical fiber coupled to the optical filter for carrying the filtered signal; and

f. a receiving system coupled to the second length of optical fiber to receive the filtered signal.

21. The fiber optic communication system as claimed in claim 20 wherein the transmission system includes a multiplexer and a plurality of transmitters coupled to the multiplexer for transmitting the optical signal.

22. The fiber optic communication system as claimed in claim 21 wherein the receiving system includes a demultiplexer and a plurality of receivers coupled to the demultiplexer for receiving the filtered signal.

23. A fiber optic communication system for transmitting an optical signal comprising:

a. a transmission system configured to receive and transmit the optical signal;

b. a first length of optical fiber coupled to the transmission system for carrying the optical signal;

c. an optical filter coupled to the first length of optical fiber for filtering the optical signal, thereby forming a filtered signal, the optical filter including:

i. a fiber optic core having a first diameter, a filter length, a first index of refraction, a first end for receiving the amplified signal, and a second end for transmitting the filtered signal;

ii. an inner cladding formed concentrically about the fiber optic core, the inner cladding having a second index of refraction and a first thickness, wherein the second index of refraction is less than the first index of refraction; and

iii. an outer cladding formed concentrically about the inner cladding, the outer cladding having a third index of refraction, wherein the third index of refraction is greater than the second index of

refraction and the third index of refraction is less than the first index of refraction, wherein the first diameter and the first thickness are of dimensions to promote evanescent coupling between the fiber optic core and the outer cladding to filter the optical signal;

d. an amplifier coupled to the optical filter for amplifying the filtered signal thereby forming an amplified signal having a flattened gain;

e. a second length of optical fiber coupled to the amplifier for carrying the amplified signal having the flattened gain; and

f. a receiving system coupled to the second length of optical fiber to receive the amplified signal having the flattened gain.

24. The fiber optic communication system as claimed in claim 23 wherein the transmission system includes a multiplexer and a plurality of transmitters coupled to the multiplexer for transmitting the optical signal.

25. The fiber optic communication system as claimed in claim 24 wherein the receiving system includes a demultiplexer and a plurality of receivers coupled to the demultiplexer for receiving the filtered signal.

26. A method of manufacturing an all fiber optical filter, which begins with an optical fiber having a core, inner cladding, and outer cladding, comprising:

a. holding the optical fiber between a first clamp and a second clamp;

b. heating a length of the optical fiber between the first clamp and the second clamp; and

c. stretching the optical fiber by further separating the first clamp and the second clamp until a predetermined characteristic is achieved.

27. The method as claimed in claim 26 wherein the predetermined characteristic is a stretch length of the optical fiber.

28. The method as claimed in claim 27 wherein the step of heating includes heating the length of optical fiber to a temperature within the range of 900 °C to 1100 °C.

29. The method as claimed in claim 28 wherein the step of stretching is completed by using a first stepper motor that controls the movement of the first clamp and a second stepper motor that controls the movement of the second clamp.

30. The method of claim 26 wherein the predetermined characteristic is an optical spectrum response of the optical fiber.

31. The method as claimed in claim 30 wherein the optical spectrum response is measured using a white light source and an optical spectrum analyzer.

32. The method as claimed in claim 31 wherein the predetermined optical spectrum response is based upon an inverse of a portion of an amplifier gain spectrum such that upon cooling of the all fiber optical filter, the optical spectrum response will be nearly equal to the inverse of the portion of the amplifier gain spectrum.

33. The method as claimed in claim 32 wherein the temperature is within the range between and including 900 °C to 1100 °C.